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OCCUPATION EDUCATION REQUIREMENTS ANALYSIS.

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THE OCCUPATIONAL EDUCATION REQUIREMENTS ANALYSIS (OERA) SYSTEM IS A RESEARCH EFFORT DESIGNED TO DEVELOP A FEASIBLE METHOD OF PROJECTING VOCATIONAL EDUCATION REQUIREMENTS THAT WILL SATISFY LABOR MARKET NEEDS. THE OUTPUTS OF THE OERA WILL BE ANNUAL PROJECTIONS OF EMPLOYMENT DEMANDS IN OCCUPATIONS CLASSIFIED BY VOCATIONAL EDUCATION PROGRAMS. THESE WILL REPRESENT THE NUMBER OF EMPLOYEES NEEDED IN POSITIONS FOR WHICH THAT TYPE OF VOCATIONAL PREPARATION WOULD HAVE EQUIPPED THEM RATHER THAN THE NUMBER OF EMPLOYEES WHO WILL HAVE RECEIVED THE VOCATIONAL PREPARATION. THE OERA SYSTEM CONSISTS OF A THREE-STEP PROCESS--(1) IT ASSUMES EMPLOYMENT PROJECTIONS TO A TARGET YEAR FOR EACH OF A NUMBER OF ECONOMIC SECTORS, (2) IT ASSUMES HAVING INFORMATION ON THE PROPORTION OF TOTAL EMPLOYMENT IN EACH ECONOMIC SECTOR WITH THE SELECTED TYPES OF EDUCATIONAL PREPARATION, AND (3) THE END RESULT IS OBTAINED BY MULTIPLYING EMPLOYMENT, SECTOR-BY-SECTOR, IN THE SPECIFIED STATE OR LOCALITY BY THESE PROPORTIONS AND SUMMARIZING BY THE TYPE OF EDUCATION. PRELIMINARY COMPUTER RUNS HAVE PROVIDED DATA THAT ARE INDICATIVE OF FUTURE POSSIBILITIES ONLY, RATHER THAN SUITABLE FOR CURRENT USE FOR PLANNING PURPOSES. A CLASSIFICATION OF ECONOMIC SECTORS AND A DESCRIPTION OF THE COBOL AND FORTRAN COMPUTER PROGRAMS ARE INCLUDED. (MM)

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

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Division of Operations Analysis

OCCUPATION EDUCATION REQUIREMENTS ANALYSIS

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CONTENTS

LIST OF TABLES..... iii

LIST OF ILLUSTRATIONS..... iv

I. INTRODUCTION..... 1

Need For Better Forecasting..... 1
Changing Role of Education..... 1
Increasing Demand for Post-High School Training.... 2

II. THE OERA SYSTEM DEVELOPMENT..... 2

The Approach..... 2
Description of the OERA System..... 4

III. PRELIMINARY RESULTS..... 13

IV. SOME ANALYTICAL COMPARISONS..... 18

National and Area Comparisons - 1966..... 18
Sensitivity to Sectoral Redefinitions..... 19
Economic Growth: The Impacts of Variable Growth Patterns..... 23

V. FURTHER DEVELOPMENT..... 25

Variable Education Coefficients..... 25
A Rebasing System..... 26
Problems of Definition and Expansion..... 26
Continuing System Development..... 27

APPENDIXES

A. Classification of Economic Sectors..... 28
B. Computer Programs..... 30

BIBLIOGRAPHY..... 35

LIST OF TABLES

Table		Page
1.	Distribution of Vocational Skills By Industry	9
2.	Sample Page Printout: Part of Massachusetts	10
3.	Sample Page Printout: U.S. Totals	11
4.	Office Occupations Employment Albany-Schenectady-Troy SMSA	12
5.	Vocational Education Requirements	16
6.	Percent Distribution of Projected Enrollments and Projected Manpower Requirements	17
7.	Nonagricultural Employment in 1966	20
8.	Sensitivity Analysis	22
9.	Vocational Education Requirements Under Variable Growth Assumptions	24

LIST OF ILLUSTRATIONS

Figure		Page
1.	Educational Attainment of the Civilian Labor Force.....	3
2.	Percent Change in Vocational Education Employment 1966-1975.....	14
3.	Data Processing Flow.....	33

OCCUPATION EDUCATION REQUIREMENTS ANALYSIS

1. INTRODUCTION

Need For Better Forecasting

With the passage of the Vocational Education Act of 1963 [1/] came the need for greater care in the planning of vocational education programs to make them more responsive to the nation's economic goals. The new law provided for greatly expanded coverage of eligible training programs as well as for increased amounts of financial support which were to be directed toward providing occupational training to meet manpower needs. The purpose of the "Occupation Education Requirements Analysis" (OERA) is to develop a method of forecasting tomorrow's labor force in terms of educational requirements and to evaluate the usefulness of this method. A system of providing educational requirements projections at the state and Standard Metropolitan Statistical Area level should perform a key role in planning vocational programs.

Changing Role of Education

Furthermore, education will be playing an increasingly important role in the future, a role in which it will tend to shift away from some of the fields which it has emphasized in the past. Because it will be coping with the continuing movement of population from rural to urban centers, vocational education must continue to shift its emphasis away from programs in agriculture and home economics to concentrate more on the technology implied by increasing urbanization. In particular, the increasing emphasis on aiding the "disadvantaged" sharply underscores the new responsibilities that vocational training in schools will be assuming in the next few years.

Urban areas experiencing a shift in character as a result of the migration of the affluent from cities to suburbs must deal increasingly with underprivileged groups. This shift in the characteristics of the urban population has left central cities with school systems which have a large proportion of students with no appreciation for the traditional types of learning. These students do have an appreciation for jobs and income from employment and they see the connection between their education and possible employment opportunities. Consequently, urban school systems must review the emphasis they are now putting on vocational education in order to help prepare these students for useful lives in society. To develop these programs will require planning which will meaningfully relate them to the economic environment which these students will enter.

[1/] Public Law 88-210

Increasing Demand for Post-High School Training

Finally, as we see in Figure 1, there will be a large increase in the proportion of the labor force with some post-high school education. This group, in turn, will generate increased demands for trained technicians. One common rule of thumb, for example, is that every four scientists or engineers should be supported by three technicians trained in their fields.[1/] The increasing number of professionals will thus, per se, generate new demands for technicians at the below-college graduate level.

The vocational education system must plan carefully to meet these demands, and for this purpose a key requirement is for projections of what the demands will be. The OERA system is one step toward meeting this requirement--the projections provided here are very rough estimates but do show how it is possible to provide an internally consistent set of economic projections with which the educational planner can operate.

II. THE OERA SYSTEM DEVELOPMENT

The OERA system is a research effort designed to develop a feasible method of projecting vocational education requirements that will satisfy labor market needs.

A. The Approach

To achieve the desired result, the OERA system had to have projections for the State, and whenever possible for the local level. The data are, of course, capable of aggregation to whatever summary level is desired. It is obvious that such estimates, made as they are at the microeconomic level, are subject to a great deal of uncertainty. But even though estimates for individual small areas are expected to be uncertain, if they are made within the framework of national projections they will be consistent when summarized to national levels. Individualized estimates at the State and local level do not provide this assurance. The Federal administrator who is equipped with national, State, and local projections on a consistent basis will be in a stronger position to provide guidance to officials at the State and local levels.

The approach used here is based on projected demand--what educational planners call the "manpower" approach. Use of the manpower approach has been criticized on several counts, the most relevant of which is that it too narrowly restricts the objectives of education to attainment of economic goals as opposed to broader social goals. It is difficult to see, however, how an advanced country such as the United States can satisfy its requirements for skilled workers on any other basis. In this country the educational system must provide some of the required skilled workers and the planning of vocational education programs is specifically related to the satisfaction of this requirement.

1/ See 9, pp. 32-36. The ratios vary with industry, ranging from .28 technicians per scientist/engineer in Mining to 6.47 in Medical & Dental Laboratories.

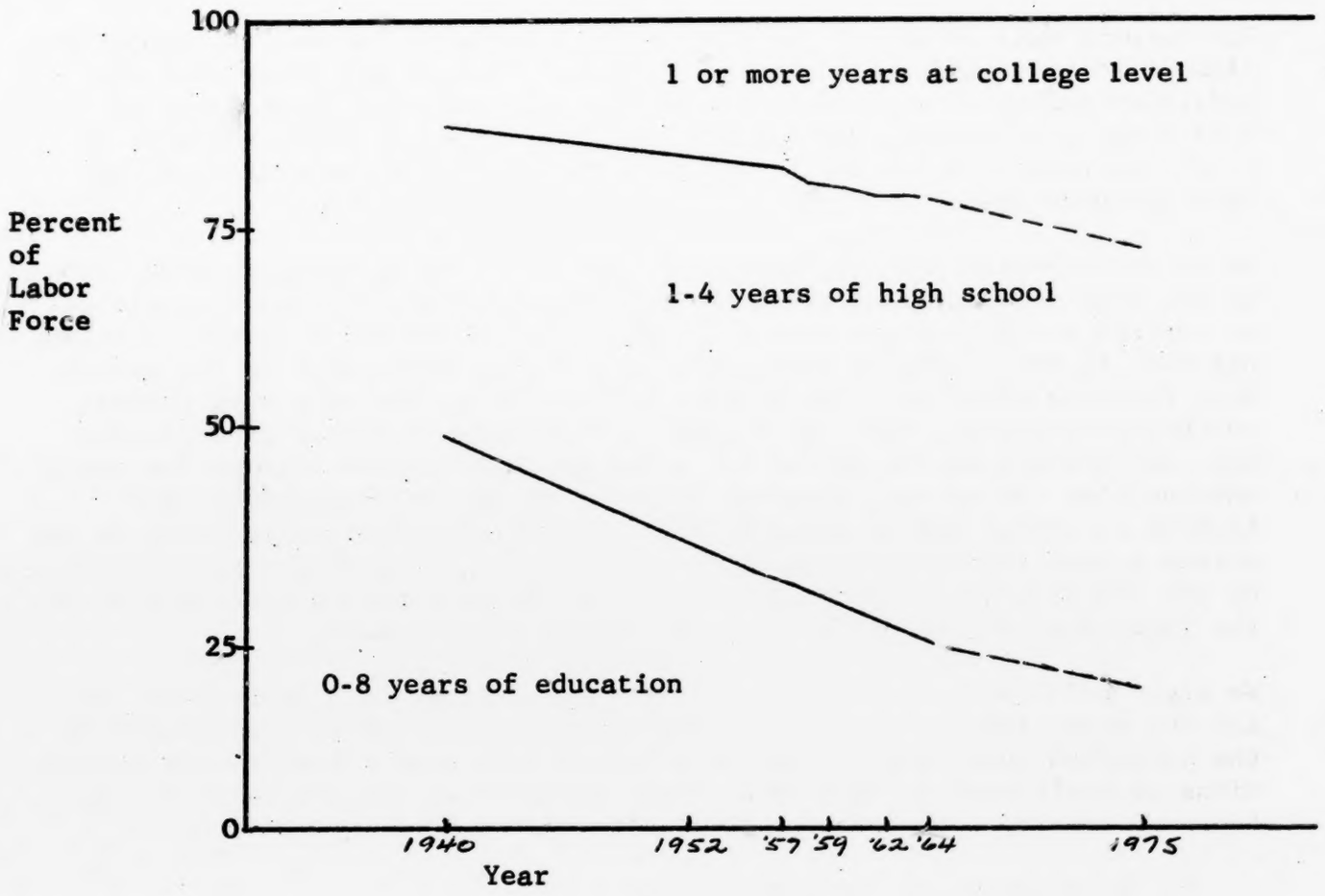

Fig. 1. Educational Attainment of the Civilian Labor Force 18 to 64 years Old, Selected Years, 1940-64, and Projections for the Civilian Labor Force 25 Years Old and Older, 1975.

By 1975 19% of the labor force will have had only a grade school education. The vocational education planning system should aim at the large middle band, while the higher education planning system must provide for the increasingly important top band.

Source: Denis F. Johnston, "Educational Attainment of Workers, March 1964," Monthly Labor Review, 88 (May 1965), p.518.
U.S. Department of Labor, Manpower Report of the President (Washington: Government Printing Office, March 1966), p.218.

Outputs

The outputs will be annual projections of employment demands in occupations classified by vocational education program. They do not imply that the indicated number of employees necessarily will have had these types of vocational preparation, but rather that this number of employees will be needed in positions for which that type of vocational preparation would have equipped them.

We do not directly project employment opportunities by occupation but rather by the type of vocational preparation which would be utilized by employees in various sectors of the economy, regardless of whether a specific individual did, in fact, receive such training prior to employment in the sector. Some training will have come through experience on the job, some through on-the-job training, and some through other formal training arrangements. Many individuals may be either untrained or inadequately trained for their occupations. We assert, however, that to the extent requirements for trained personnel can be foreseen and training programs carried out, we can attain a more satisfactory matching of skills to jobs, higher productivity on the job will be achieved, and there will be an enhanced contribution of the individual to his own and his employer's satisfaction.

We might point out, in addition, that by considering only employment, we are not answering the question of how many persons must be graduated from the specified vocational education programs each year. From annual projections of employment in each educational category we can arrive at indications of the types of training that will be in demand in the future.

B. Description of the OERA System

Obtaining vocational education projections is a three-step process. First, we assume that we have employment projections to some target year (1975 in our case) for each of a number of economic sectors, by State and by Standard Metropolitan Statistical Area (SMSA). We further assume that we have information on the proportion of total employment in each economic sector with the selected types of educational preparation. The end result is obtained by multiplying employment, sector-by-sector, in the specified State or locality by these proportions and summarizing by type of education. (The format of the output can be seen in Tables 2 and 3.)

This approach introduces two problems which must be analyzed. First, it may well be that "economic sector" is not the appropriate conceptual device for linking educational requirements and economic activity. However, its widespread use by economists for making economic projections makes it convenient to use.

The other problem is that of defining educational planning areas. States plan their vocational education programs on the basis of Labor Market Areas, most of which have been formally defined by the U.S. Bureau of Employment Security (10). On the other hand, economic projections are usually based on SMSA's which may or may not be coterminous with labor market areas. No resolution of this problem seems immiment.

(1) The Employment Projections

It was not our objective to make detailed employment projections, but rather to use whatever set of projections seemed to fit our requirements best. Those prepared by the National Planning Association (NPA) (Refs. 4 and 5), despite some shortcomings, appeared to meet our major requirements. Two basic requirements were that the projections provide industry detail and that this detail be carried down to the State and local level; both of these were met by the NPA data.

By the same token we were limited by the constraints imposed by these data. They are available in both State and metropolitan area formats for only eleven industry groups. Quite divergent vocational requirements may well be concealed within some of these broader groupings--especially in manufacturing. An increase in textiles manufacturing for example, may generate a quite different pattern of labor force education requirements from a comparable increase in industrial chemicals manufacturing.

Use of Selected SMSA's

Another limitation is that only 82 standard metropolitan statistical areas (SMSA's) are represented, so that rural-urban shifts are not displayed as clearly as we might wish. Since we separate each State into its metropolitan areas (where there are any) and treat the remainder of the State as a residual, these residuals will include SMSA's which are not among our list of 82. An idea of the extent of this problem is given by the fact that the selected 82 SMSA's included 51% of all U.S. employment in 1962, and 74% of all SMSA employment in that year.1/

Another problem is that posed by SMSA's which crossed State boundaries. Since vocational education is planned by States, it is necessary to split these SMSA's into their State components in order to specify educational requirements within each State.

1/ Projections now in preparation will include all 214 SMSA's of the 1960 Census and will thus cover a higher proportion of total urban employment.

Use of Employment Projections

Our final problem, rather easily resolved, is that NPA provided actual employment for 1962 and projected employment for only 1970 and 1975; exponential interpolations were made for intervening years.

It is not necessary, of course, to use NPA estimates--the OERA system is flexible enough to accept various employment projections as they become available. Some of the analyses below are, in fact, based on alternative projections. Relatively few projections, however, are detailed by State and SMSA.

(2) The Occupation/Education Coefficients

Detailed vocational educational categories are now being compiled and defined by the National Center for Educational Statistics and formal descriptions are in preparation. A preliminary list of several hundred categories has been prepared by the Division of Statistical Operations and sent to the field for review and comment (8).

Since the Vocational Education Act of 1963 was comprehensive in coverage, providing support for training leading to all occupations except those that require a baccalaureate or higher degree, our work is designed to encompass all of the seven vocational educational categories which form the planning and reporting basis for such programs.1/

1/ The seven vocational education categories are agriculture, distribution and marketing, health, home economics, office occupations, technical training, and trades and industry. "Agriculture" includes not only farm-related programs but also horticulture, gardening, agriculture products development, etc. "Distribution and Marketing" includes fields such as selling, store management, advertising, etc. "Health Occupations" is self-explanatory. "Home Economics," as an occupational area, includes home managers, counselors, nutritionists, dieticians, and similar occupations. "Office Occupations" includes the expected clerical and secretarial skills as well as many of the rapidly growing data processing-connected occupations. "Technical Training" includes occupations dealing with specialized technical areas usually involving the use or adjustment of scientific instruments. "Trades and Industries" cover the blue-collar occupations.

With the detailed vocational program descriptions of Reference 8, it is possible to relate each of the occupations separately identified in the 1960 Census to one of these seven programs. In order to use the 1960 Census (1/1000 sample tape) as a basis for computing occupation/education coefficients, it is necessary to provide first a conversion table which would relate these Census occupations to vocational education categories. This, with a similar table converting Census industries to the eleven economic sectors used by the NPA, used to develop the set of coefficients of Table 1.

We should note that occupational information is not available from the 1960 Census for about 4.7 million workers, or 7% of the labor force reported by the 1960 monthly household survey made by the Census Bureau for the Bureau of Labor Statistics; of these there were 3.2 million not reporting occupations, and 1.5 million representing an unexplained undercount compared with estimates of the monthly household survey. For those not reporting occupation we assigned the "none" education code, on the assumption that where occupation is not known or not reported it is likely to be an unskilled classification.

Occupational Structures

Table 1 shows that there are significant differences in occupational structures among industries, thus indicating that the "economic sector" is indeed a meaningful concept when applied to vocational education demands. We may note, for example, the (not surprisingly) high proportion of distributive occupations in Wholesale and Retail Trade and the high incidence of office occupations in both Finance and Federal Government. We may also observe that the coefficients for Wholesale and Retail Trade are enough alike that we might consider combining the two without losing much precision; but the two kinds of Government sectors have quite different occupational demands and it would be wise to keep them separate, at least for purposes of projecting vocational educational requirements.

Two methodological problems in this procedure should be considered. First, within an industry the occupational structure may vary from one geographical area to the next. Secondly, the occupational structure of an industry will change over time. This reflects not only a tendency for the actual work content of occupations to be upgraded over time, but also the technological changes that affect the industry's demand for workers.

(3) Computer Programming

Two programs are involved in this system. One is a COBOL program, prepared by the Division of Automatic Data Processing of the National Center for Educational Statistics which utilizes the Bureau of the Census 1/1000 sample to prepare coefficients. The other, a FORTRAN program prepared by the Division of Operations Analysis of the Center projects educational requirements by area and prepares the reports. The total system flow is shown schematically in Figure 3, page 33.

The Coefficient Program

It is possible to foresee a variety of types of coefficients which might be useful in making projections of vocational education needs. A common denominator, however, is the requirement for a matrix with industry and vocational education dimensions. The capability of obtaining such a matrix by classifying Census industries into a variety of more aggregative economic sectors and by classifying and converting Census occupations into a variety of vocational education groupings appears to offer the greatest flexibility for the present analysis. The computer program is written to provide this capability.

The output of the program is a list of coefficients which shows for each sector the distribution of employment among the selected educational groupings. Table 1 is an example of such a list.

The Projections Program

The projections calculations are prepared by a FORTRAN program. Briefly, the program reads into memory for retention the coefficients of Table 1 that indicate the proportion of workers in each industry who are employed in jobs that require a specific vocational skill. Then, industry-by-industry employment projections for each geographic area are read, multiplied by the appropriate set of coefficients, and summed for the geographic area. In order to provide educational projections for non-SMSA areas in each State, we compute State totals and subtract the SMSA's which fall in that State. On completion of computations for an area, the results are printed out in tabular form (Tables 2 and 3 are illustrative samples of the output). The program also obtains a grand total for the U.S. and the 82 SMSA's separately.

TABLE 1
DISTRIBUTION OF VOCATIONAL SKILLS BY INDUSTRY

INDUSTRY	VOCATIONAL EDUCATION CATEGORY 1/								
	Agriculture	Distrib. & Marketing	Health Occup.	Home Economics	Office Occup.	Technical Education	Trade & Industry	Other	Total
Agriculture, Fisheries	.9251	.0028	.0014	.0002	.0133	.0091	.0454	.0027	1.0000
Mining	.0114	.0032	.0000	.0000	.1315	.0065	.7760	.0714	1.0000
Construction	.0042	.0026	.0000	.0018	.1462	.0078	.7886	.0488	1.0000
Manufacturing	.0094	.0398	.0016	.0018	.1817	.0111	.6752	.0794	1.0000
Communications, Transportation, etc.	.0048	.0106	.0004	.0055	.2856	.0055	.6047	.0829	1.0000
Wholesale Trade	.0117	.2544	.0000	.0022	.4270	.0027	.2499	.0521	1.0000
Retail Trade	.0013	.2978	.0008	.0036	.3063	.0000	.3330	.0572	1.0000
Finance, Insurance	.0159	.2678	.0007	.0119	.5903	.0011	.0746	.0377	1.0000
Other Services	.0080	.0096	.1071	.1566	.1678	.0048	.2419	.3042	1.0000
Federal Government	.0151	.0017	.0045	.0022	.6399	.0156	.1731	.1479	1.0000
State and Local Government	.0226	.0029	.0066	.0051	.3606	.0088	.4460	.1474	1.0000

1/ The figures represent that proportion of total employment in each industry which falls into each vocational category. For example, 15.7% of the employees in the "Other Services" sector were working (in 1960) at jobs for which educational programs in Home Economics would have prepared them.

Note : Totals may not add to 1.0000 because of rounding.

Source: Estimated by the Division of Operations Analysis, Office of Education

TABLE 2. SAMPLE PAGE PRINTOUT:
PART OF MASSACHUSETTS

VOCATIONAL + TECHNICAL EMPLOYMENT PROJECTIONS
(Thousands of Employees)

	AGRIC	DIST	HEALTH	HOME EC	OFF OCC	TECH ED	TR+IND
4.005 LAWRENCE MASS							
1966	1.4	7.6	1.2	1.8	21.4	.7	48.4
1967	1.4	7.9	1.3	1.9	22.2	.7	49.9
1968	1.5	8.2	1.3	2.0	23.1	.8	51.4
1969	1.5	8.5	1.4	2.1	24.0	.8	53.0
1970	1.6	8.8	1.5	2.2	24.9	.8	54.6
1971	1.6	9.1	1.5	2.3	25.8	.8	56.4
1972	1.6	9.4	1.6	2.4	26.7	.9	58.3
1973	1.6	9.8	1.7	2.5	27.6	.9	60.2
1974	1.6	10.1	1.7	2.6	28.6	.9	62.2
1975	1.6	10.4	1.8	2.7	29.6	1.0	64.2
4.006 LOWELL MASS							
1966	.9	5.9	.8	1.2	15.1	.4	29.0
1967	.9	6.4	.9	1.3	16.0	.4	30.0
1968	.9	6.9	1.0	1.5	17.0	.4	31.2
1969	1.0	7.5	1.1	1.6	18.1	.4	32.4
1970	1.0	8.1	1.2	1.8	19.4	.4	33.7
1971	1.0	8.4	1.1	1.8	19.9	.4	34.3
1972	1.0	8.7	1.1	1.7	20.4	.5	34.9
1973	1.0	9.0	1.1	1.7	20.9	.5	35.6
1974	1.0	9.3	1.1	1.7	21.5	.5	36.2
1975	1.0	9.6	1.0	1.6	22.1	.5	36.9
4.007 PRVDNCE-PAWTUCKET MA							
1966	.7	3.4	.8	1.2	10.9	.3	18.8
1967	.7	3.7	.8	1.2	11.5	.3	19.3
1968	.8	4.2	.9	1.3	12.4	.3	19.8
1969	.8	4.7	.9	1.3	13.4	.3	20.5
1970	.9	5.4	.9	1.4	14.7	.3	21.3
1971	.9	5.6	1.0	1.4	15.3	.3	21.8
1972	.9	5.8	1.0	1.5	15.9	.3	22.3
1973	.9	5.9	1.0	1.5	16.6	.4	22.8
1974	.9	6.1	1.0	1.6	17.4	.4	23.4
1975	.9	6.3	1.1	1.6	18.2	.4	24.0
4.999 REST OF MASS							
1966	25.6	51.4	23.5	34.4	195.3	6.2	396.0
1967	24.9	50.1	23.5	34.3	193.5	6.2	394.0
1968	24.2	48.7	23.4	34.3	191.4	6.2	391.8
1969	23.5	47.1	23.4	34.2	189.0	6.2	389.2
1970	22.8	45.3	23.3	34.0	186.1	6.1	386.2
1971	22.0	44.5	24.0	35.1	186.1	6.2	386.3
1972	21.2	43.6	24.8	36.2	186.1	6.2	386.4
1973	20.5	42.7	25.6	37.3	186.0	6.2	386.4
1974	19.9	41.8	26.4	38.4	185.9	6.2	386.4
1975	19.2	40.9	27.2	39.6	185.7	6.3	386.4

Source: Division of Operations Analysis, Office of Education

TABLE 3. SAMPLE PAGE PRINTOUT:
U. S. TOTALS

VOCATIONAL - TECHNICAL EMPLOYMENT PROJECTIONS
(Thousands of Employees)

	AGRIC	DIST	HEALTH	HOME EC	OFF OCC	TECH ED	TR-IND
TOTAL UNITED STATES							
1966	5010.0	5818.1	1531.5	2276.1	18236.3	448.7	30291.0
1967	4920.6	5939.1	1570.7	2334.2	18632.5	457.2	30877.7
1968	4834.5	6063.6	1611.1	2394.1	19042.6	466.0	31484.1
1969	4751.7	6191.8	1652.7	2455.8	19467.0	475.1	32110.7
1970	4672.1	6323.8	1695.6	2519.5	19906.3	484.5	32758.3
1971	4589.4	6445.7	1752.0	2602.2	20327.8	493.1	33335.9
1972	4510.1	6570.8	1810.4	2688.0	20763.9	501.9	33932.7
1973	4434.3	6699.3	1870.9	2776.9	21215.2	511.1	34549.3
1974	4361.9	6831.2	1933.7	2869.2	21682.3	520.6	35186.5
1975	4292.9	6966.8	1998.9	2964.8	22170.0	530.5	35846.3
82 METROPOLITAN AREAS							
1966	854.6	3727.9	813.3	1226.3	10920.3	245.8	16905.0
1967	860.5	3828.4	847.5	1277.2	11241.0	252.5	17367.9
1968	867.1	3933.0	883.5	1330.7	11576.9	259.5	17851.9
1969	874.6	4041.8	921.2	1386.9	11928.7	266.9	18358.4
1970	883.0	4155.3	960.9	1445.9	12297.6	274.6	18888.6
1971	887.2	4244.2	995.3	1496.9	12579.5	280.1	19282.5
1972	892.1	4336.0	1031.1	1550.0	12873.1	285.9	19692.3
1973	897.7	4431.0	1068.4	1605.4	13179.0	291.9	20118.7
1974	904.0	4529.2	1107.3	1663.0	13497.8	298.2	20562.6
1975	911.1	4635.5	1147.9	1723.2	13836.4	304.9	21030.0
REMAINDER OF U. S.							
1966	4155.4	2090.2	718.2	1049.8	7316.0	202.9	13386.0
1967	4060.1	2110.7	723.2	1057.0	7391.4	204.7	13509.8
1968	3967.4	2130.7	727.6	1063.4	7465.7	206.5	13632.1
1969	3877.1	2150.0	731.5	1069.0	7538.2	208.2	13752.3
1970	3789.1	2168.5	734.7	1073.6	7608.7	210.0	13869.7
1971	3702.2	2201.5	756.7	1105.3	7748.3	213.0	14053.4
1972	3618.0	2234.8	779.3	1138.0	7890.8	216.0	14240.3
1973	3536.6	2268.3	802.5	1171.6	8036.2	219.1	14430.6
1974	3457.9	2302.0	826.4	1206.1	8184.5	222.3	14623.9
1975	3381.8	2331.3	851.0	1241.6	8333.6	225.7	14816.3

Source: Division of Operations Analysis, Office of Education

Computationally, consider E, the n x m matrix of Table I, where n is the number of sectors and m the number of educational categories. Then for each state or metropolitan area we have P, the t x n matrix of employee projections for each of t years in each of n sectors. The matrix product

$$\underset{(txn)}{P} \cdot \underset{(nxm)}{E} = \underset{(txm)}{PE}$$

is the set of projections illustrated by Tables 2 and 3. To illustrate this procedure for one year (1975) and one educational category (Office Occupations), consider the following example for the Albany-Schenectady-Troy SMSA:

TABLE 4. OFFICE OCCUPATIONS EMPLOYMENT
Albany-Schenectady-Troy SMSA

Industry	1975 Employment (thousands)	Proportion of Employment in Office Occupations	Employment In Office Occupations (thousands)
Agriculture	5.0	.0133	0.1
Mining	0.9	.1315	0.1
Construction	16.7	.1462	2.4
Manufacturing	53.7	.1817	9.8
Transportation, communications, and public utilities	18.0	.2856	5.1
Wholesale trade	17.4	.4270	7.4
Retail trade	45.3	.3063	13.9
Finance, insurance, and real estate	14.6	.5903	8.6
Services	49.4	.1679	8.3
Federal government	8.7	.6399	5.6
State & local government	69.0	.3606	24.9
TOTAL	298.7	----	86.2

SOURCE: Reference 4 and Table 1.

It is clear from the foregoing discussion that changes in projections and/or occupation/education coefficients may easily be represented by changes in the P and E matrices, the only requirement being that the two conform to each other.

III. PRELIMINARY RESULTS

Preliminary computer runs have provided data that are indicative of future possibilities only, rather than suitable for current use for planning purposes. Data for Health Occupations and Technicians seem to be far below the generally accepted projections in these categories. Other data inconsistencies were also noted. Nevertheless, some trends are of sufficient interest to justify comment.

The rural-urban shift in projected employment is reflected in our projections and emphasizes the need for expanding urban programs. The following table shows the estimated distribution in employment for 1966 and 1975 (Table 3):

	1966	1975
82 SMSA's	53.9%	57.6%
All other	46.1	42.4

As noted earlier, the 82 SMSA's included in our initial projections accounted for 74% of the employment in all SMSA's in 1962. Assuming this ratio continues unchanged, we see that the SMSA-all other employment distribution is:

	1966	1975
All SMSA's	72.8%	77.8%
All other	27.2	22.2

Overall trends by type of vocational education employment show few surprises. The estimated 1966-1975 percentage growth for the U.S. can be seen on the following chart:

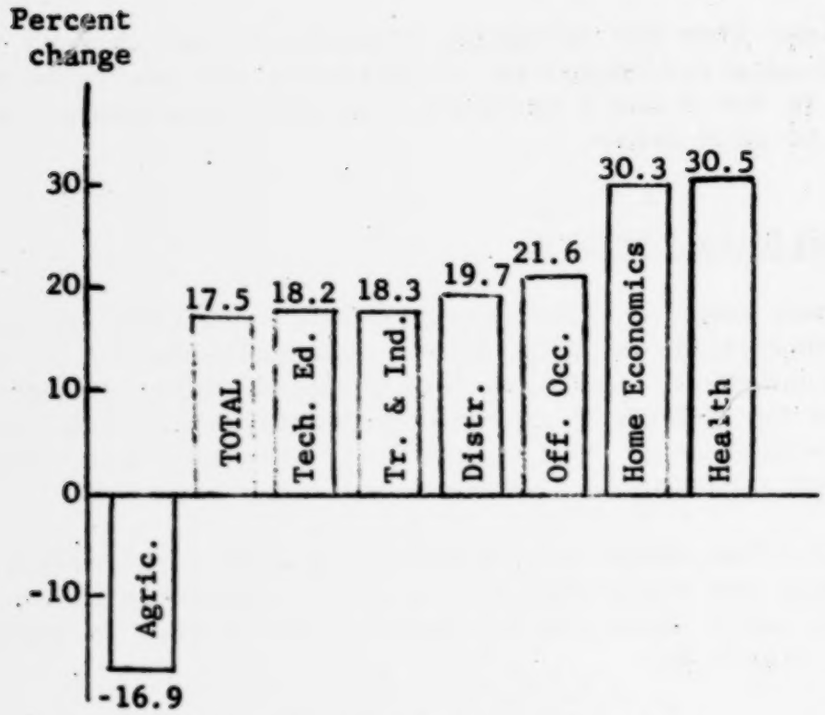

Fig. 2. Percent Change in Vocational Education Employment 1966-1975

As we have already observed, the growth figures for both Health Occupations and Technicians seem too low. A comparison of some of our employment projections with those provided by the Bureau of Labor Statistics shows the necessity of providing projections specifically oriented toward education planning. To illustrate, consider the following data, where OERA projections are aligned with those of the BLS for occupations which should be closely related:

1975 Projected Employment
(Millions)

OERA Education Category:		BLS Occupation:	
Office occupations	22.2	Clerical & kindred	14.6
Dist. & Marketing	7.0	Salesworkers	5.8
Trades & Industry	35.8	Operatives & kindred) Craftsmen, foremen, & kindred)	26.7
Agriculture	4.3	Farm workers	3.5

It is clear that BLS definitions are different enough from those relevant to educational planning to limit their usefulness for this purpose. As noted earlier, Office Occupations include more than just clerical workers; BLS categories do not specifically identify Health Occupations, and there are also other differences in definition. The OERA system allows us to translate BLS definitions into vocational education categories.

Direct comparisons of OERA results with projections based on BAVLP data cannot be made; a somewhat more meaningful comparison would be vocational education program graduates vs. required new entrants to the labor force in the corresponding occupational categories. Our figures show net year-to-year differences, but do not give any information on attrition, which must also be made good by new entrants. Table 5 shows the differences between figures implied by our projections and those of the BAVLP.

Data shown in Table 6 facilitate comparison of the percentage distribution of estimated vocational program enrollments with the percentage distributions of the work force provided by OERA. For the years 1966, 1970, and 1975, trends in the two sets of figures are comparable. In the case of the four largest programs, (Agriculture, Home Economics, Office Occupations, and Trades and Industry) the distribution of enrollments will be much closer to distributions of employment provided by OERA at the end of the period than at the beginning.

Analyses of individual State and SMSA projections will provide planners with indications of trends that run counter to U.S. experience as a whole. The following observations are made in order to demonstrate the types of conclusions that can be deduced from OERA projections:

(a) Generally, all manpower categories show an increase in the 82 SMSA's, while agriculture alone shows a decline in the U.S. as a whole outside these SMSA's. Agricultural occupations rose within SMSA's because of an increasing demand for gardeners, horticulturists, etc., by sectors other than the agriculture sector.

(b) West Virginia, outside its SMSA, shows an increase--a very small one--only in office occupations. All other occupations will decline.

(c) The Phoenix SMSA shows a decline in agriculture, contrary to the national trend, while the rest of Arizona shows a rise in agricultural manpower requirements--again contrary to national experience.

TABLE 5

VOCATIONAL EDUCATION REQUIREMENTS

(In Thousands Unless Otherwise Noted)

Educational Category (1)	Enrollments According To BAVLP		Available For Placement (On BAVLP Base) 1/			Net New Requirements Estimated By OERA 1975 2/
			1965		1975	
	1965	Projections For 1975	Number	Percent		
	(2)	(3)	(4)	(5)	(6) (3) x (5)	(7)
Agriculture	888	1,230	76.2	8.6	106	-76
Distribution	333	1,440	55.3	16.6	239	+113
Health	67	1,450	15.8	23.6	342	+65
Home Econ.	2099	2,100	13.5	0.6	13	+105
Office Occ.	731	2,400	212.2	29.0	696	+495
Technical	226	1,260	53.3	23.6	297	+10
Trades & Industry	1088	4,120	137.5	12.6	519	+687
Total	5432	14,000	563.8	10.4	2,212	1,399

1/ Refers to the number of vocational education program graduates available to enter the labor force. The percent of total enrollment thus available in 1965 is used with estimated enrollments for 1975 to estimate the number of graduates available for placement in the latter year.

2/ Net new requirements are the difference between OERA projections for 1974 and 1975. If we add annual attrition (approximately 1.5 million or twenty percent of the total labor force in vocational education fields) to the OERA total, we get a total requirement for 2.9 million workers. This compares with the 2.2 million who are expected to be graduated from vocational education programs.

Source: Division of Operations Analysis and Bureau of Adult, Vocational and Library Programs, Office of Education

TABLE 6

PERCENT DISTRIBUTION OF PROJECTED ENROLLMENTS AND PROJECTED MANPOWER REQUIREMENTS 1/

Educational Category	1966		1970		1975	
	Projected Enroll.	OERA Manpower Reqts.	Projected Enroll.	OERA Manpower Reqts.	Projected Enroll.	OERA Manpower Reqts.
	Percent of total	Percent of total	Percent of total	Percent of total	Percent of total	Percent of total
Agriculture	15.0	7.0	11.0	6.7	9.0	5.6
Distribution	7.0	7.3	9.0	7.4	10.0	7.5
Health Occ.	3.0	2.4	7.0	2.5	10.0	2.7
Home Econ.	34.0	3.5	24.0	3.6	15.0	3.9
Office Occ.	14.0	28.8	15.5	29.3	17.0	29.9
Technical	4.5	0.7	7.0	0.7	9.0	0.7
Trade & Industry	22.5	49.4	26.5	49.7	30.0	49.7
Total	100.0	100.0	100.0	100.0	100.0	100.0

1/ Although the percentage distributions are quite different, the trends are generally comparable. Thus, both enrollments and employment in agriculture will decline in percentage terms over the 1966-1975 period. In Home Economics there is a tendency toward reduced enrollments in the more general types of homemaking programs and toward increased concentration on job-oriented programs.

Note: Totals may not add to 100.0 because of rounding.

Source: Division of Operations Analysis, Office of Education

(d) Because of very high projected growth for the Denver SMSA, its requirements for Trade and Industrial manpower will increase 50% from 1966 to 1975 compared with a national growth in this category of 18.4%. This growth in Denver will be at the expense of the rest of Colorado, which will present declining employment opportunities in every field except Distribution and Marketing.

IV. SOME ANALYTICAL COMPARISONS

The purpose of this section is to show how results provided by OERA can be compared with detailed projections and current data collected by other agencies. This comparison will help to evaluate the results generated by OERA.

A. National and Area Comparisons - 1966

The basic employment data used were projections for 50 States, the District of Columbia, and 82 metropolitan areas (80 Standard Metropolitan Statistical Areas and 2 Standard Consolidated Areas) prepared by the National Planning Association. They represent civilian employment in each State or area and include wage and salary workers, the self-employed, household workers, and unpaid family workers.

The count does not include more than one employment situation for multiple jobholders. The 1957 Standard Industrial Classification was used for the 2-digit industry breakdowns. The 82 areas for which the NPA made projections were chosen as a representative sample of all SMSA's in 1962. 1/

Estimates of 1962 employment (used as the basis of projections for later years) by State and industry were made by the NPA. 2/ For each of the selected SMSA's, their primary source was wage and salary employment estimates published by the Bureau of Labor Statistics. Additional sources were employment estimates of the Bureau of Employment Security and the Office of Business Economics. After making the conceptual adjustments necessary to make the basic data conform to SMSA boundaries, the figures were adjusted to represent all employees. This last step was accomplished by adjusting the total number of self-employed household and unpaid family workers in each SMSA to fit into BLS categories and allocating the total to individual industries. The final step was to add this increment to the estimated number of wage and salary workers to get total employment for each industry in each SMSA.

1/ Alaska, Idaho, Vermont, and Wyoming had no SMSA in 1962.
2/ See Reference 5.

Differences between the NPA basic data (1962) and those compiled by BLS derive partly from variance in the inclusiveness of the figures. Another difference stems from the Office of Business Economics' treatment of employment statistics for government workers, which they make consistent with national income accounting.

Thus, certain groups of both Federal and State and local employees are included in the count for other industries in NPA data, making NPA estimates of government employment for the time period covered average about 90 percent of BLS estimates for the same years, while NPA data for some other industries exceed BLS estimates. 1/ For the years following 1962, of course, the NPA data are projections.

By taking account of these conceptual differences, it is possible to use up-to-date employment data to obtain current employment estimates which are comparable with NPA projections used by OERA. Table 7 shows, for selected areas, differences in the data from the two sources before adjustment. Although not large in percentage terms at the national level, local differences are quite pronounced.

B. Sensitivity to Sectoral Redefinitions

Given the availability of employment projections for extensively detailed economic sectors (and a correspondingly detailed occupation/education coefficient matrix) we would be able to generate national vocational education requirements comparable to those of Table 3. The purpose here is to establish whether the more detailed industry breakdown results in educational requirements projections which are significantly different from those we obtain with only eleven sectors. Although detailed sector projections are available only at the national level, and hence provide no direct assistance at the State/SMSA level, they furnish a set of national figures which would be much more desirable to the extent that detailed geographical data are consistent within national totals, local estimates would also be more soundly based.

1/ Among the largest groups of employees not included in the government count by NPA are Post Office and TVA among Federal workers, and State liquor store workers and State and local government employees.

TABLE 7

NONAGRICULTURAL EMPLOYMENT IN 1966.

Selected Areas 1/

(In Thousands)

Industry	N.Y. State BLS	N.Y. State NPA (OERA)	N.Y. SMSA BLS	N.Y. SMSA NPA (OERA)	L.A. SMSA BLS	L.A. SMSA NPA (OERA)	Houston SMSA BLS	Houston SMSA NPA (OERA)	Seattle SMSA BLS	Seattle SMSA NPA (OERA)	West Va. BLS	West Va. NPA (OERA)	United States BLS	United States NPA (OERA)
Mining	8	7	3	-	9	9	23	22	2/	-	43	37	631	555
Contract Const.	346	389	206	259	133	168	72	73	34	32	32	25	3,449	4,181
Manufacturing	1,823	1,924	1,060	1,312	794	829	114	113	154	154	124	125	19,538	18,382
Transportation	471	487	357	404	154	142	58	60	35	32	40	42	4,198	4,073
Trade	1,418	1,513	1,016	1,261	589	646	167	176	109	117	88	91	13,385	13,832
Finance	559	571	480	511	159	175	33	36	31	32	15	17	3,099	3,373
Services	1,600	1,633	1,192	999	622	667	110	86	89 2/	84	77	86	9,751	13,299
Government	878	926	560	574	314	321	58	49	66	66	76	76	11,139	9,638
TOTAL	7,103	7,450	4,874	5,320	2,774	2,957	635	615	518	517	495	499	65,190	67,334

1/ These figures show the actual 1966 employment as measured by BLS compared with the OERA figures for 1966 which are actually projections from 1962. The U.S. totals at the right were used to adjust BLS figures in order to convert them to a comparable basis.

2/ Mining combined with services.

Source: U.S. Bureau of Labor Statistics and National Planning Association.

The detailed data used for this analysis are the employment projections of BLS contained in Projections 1970 (13, pp. 122-123; see also 1) where a "basic" model for 1970 is postulated and employment projections for 77 sectors have been computed. 1/ Since actual 1965 employment is provided on a consistent basis, it is possible to make an exponential projection to 1975 in order to achieve a format which is compatible with OERA projections.

Using the coefficients program described in Section II, we can derive a coefficients matrix that conforms to the BLS projections mentioned in the preceding paragraph. This matrix can in turn be used with the seven vocational education categories to generate education requirements that can be compared to those in Table 3. 2/

Differences in concept keep the BLS 77-sector projections from corresponding to the NPA projections. The BLS projections have been adjusted to equal in concept the NPA projections and an analysis has been made to determine how a more disaggregated approach would change projected educational requirements.

Table 8 gives the results of this analysis. The upper set of data corresponds to the data presented in Table 3, the lower set is variations that reflect greater sectoral detail.

Since the two sets of data have been adjusted to achieve comparability, the variations will net to zero; the data show shifts in indicated educational requirements which the more disaggregated approach generates. These differences are large enough, in percentage terms, to indicate that the broad sector groupings used in preliminary runs are not entirely adequate for future planning purposes.

1/ These projections are based on an input-output model projection to 1970. The methodological details are given in Refs. 1 and 13. Projections based on input-output have the advantage that internal consistency in the relative output levels of each sector is achieved. The "basic" model assumes 3% unemployment and the continuation of present patterns of consumer expenditures with respect to durables and services.

2/ Because the Census industries used in OERA are somewhat less detailed than those on which BLS bases its projections for 1970, there are some instances in which it was necessary to apply the same OERA coefficients to several industrial sectors. It is unlikely that these assumed coefficients would vary significantly from the true coefficients.

TABLE 8. Sensitivity Analysis

(thousands of employees)

	AGRIC	DIST	HEALTH	HOME EC	OFF OCC	TECH ED	TR+IND
TOTAL UNITED STATES - NPA PROJECTIONS							
1966	5011.9	5868.3	1545.0	2293.3	18342.7	451.0	30595.8
1967	4922.5	6005.4	1582.5	2348.7	18736.6	459.5	31190.7
1968	4836.2	6125.0	1620.9	2405.4	19143.3	468.3	31802.6
1969	4753.0	6247.4	1660.4	2463.6	19563.3	477.4	32432.1
1970	4672.9	6372.5	1700.9	2523.2	19997.1	486.8	33079.8
1971	4588.5	6496.4	1756.9	2605.9	20388.8	494.6	33618.7
1972	4507.1	6623.0	1814.8	2691.4	20790.5	502.6	34170.6
1973	4428.4	6752.2	1874.6	2779.8	21202.3	510.8	34736.1
1974	4352.5	6884.2	1936.5	2871.1	21624.6	519.2	35315.3
1975	4279.4	7019.0	2000.5	2965.5	22057.6	527.8	35908.7
VARIATIONS BETWEEN NPA AND BLS-BASED DATA 1/							
1966	-77.4	74.5	-472.9	-616.9	-.6	15.6	18.9
1967	-81.9	80.3	-477.9	-662.7	3.2	16.6	2.4
1968	-86.5	86.3	-482.6	-710.9	7.7	17.7	-15.7
1969	-91.1	92.4	-487.1	-761.8	12.9	18.8	-35.3
1970	-95.7	98.6	-491.3	-815.5	18.9	20.1	-56.5
1971	-100.4	105.0	-495.1	-872.0	25.7	21.4	-79.4
1972	-105.1	111.5	-498.6	-931.6	33.3	22.9	-104.1
1973	-110.0	118.1	-501.7	-994.4	41.8	24.4	-130.6
1974	-114.9	124.9	-504.4	-1060.5	51.3	26.1	-159.1
1975	-119.8	131.9	-506.6	-1130.1	61.7	27.8	-189.6

1/ Figures show how projections vary when different data inputs are used. The bottom part of the table is based on data which show more industry detail than the NPA data. See page 21.

Source: Division of Operations Analysis, Office of Education

C. Economic Growth: The Impacts of Variable Growth Patterns

The educational planner, like all planners, usually wishes to determine for his programs implications of various assumptions about possible future development paths. In particular, he wishes to establish which of many contingencies will have significant impacts on his programs so that his plans can be made flexible enough to handle them. One advantage of a projection system such as OERA is that it affords an opportunity to examine several different patterns of economic growth in terms of specific impacts on vocational education programs.

BLS, in Projections 1970 (13), develops three possible alternatives to the "basic 3% unemployment" model which we utilized above. These alternatives all assume a 4% unemployment rate, but with three varying assumptions about future pattern of consumption expenditures. The "basic 4%" projection assumes that consumers will continue to divide their income among durables, nondurables, and services in accordance with present patterns; the "4% high durables" model assumes that a very recent trend toward higher relative expenditures on durables will prevail through 1970, while the "4% high services" projections are based on a shift to greater expenditures on services.

Whatever the merits of these various assumptions, our purpose here is to examine their varying impacts on vocational education requirements. The results are shown in Table 9, where the differences between each one and the "3% basic" model are shown.

At a 4% unemployment level the requirement for workers seems lower in virtually all categories. An exception to the general rule, is seen in health occupations, which would be in greater demand, even at a 4% level of unemployment, if there were a simultaneous trend toward high household expenditures on services. These results should be interpreted with caution, however, since higher levels of unemployment may be indicative of greater and not lesser needs for training--to make the unemployed workers more employable.

TABLE 9

Vocational Education Requirements Under Variable Growth Assumptions
(thousands of employees)

	AGRIC	DIST	HEALTH	HOME EC	OFF OCC	TECH ED	TR+IND
BLS 3 PERCENT BASIC PROJECTIONS							
1966	5043.8	6439.8	1138.9	1776.6	19272.0	477.9	31646.1
1967	4967.1	6577.5	1194.6	1819.4	19768.1	489.0	32292.9
1968	4893.6	6718.6	1253.1	1863.5	20284.4	500.7	32965.8
1969	4823.2	6863.1	1314.6	1908.9	20821.8	512.9	33665.9
1970	4755.9	7011.1	1379.4	1955.7	21381.4	525.8	34394.6
1971	4691.8	7162.7	1447.4	2004.0	21964.1	539.2	35152.8
1972	4630.8	7318.1	1519.0	2053.7	22571.0	553.4	35942.0
1973	4572.9	7477.2	1594.3	2105.0	23203.2	568.2	36763.5
1974	4518.2	7640.3	1673.5	2157.8	23861.9	583.7	37618.7
1975	4466.7	7807.4	1756.7	2212.4	24548.4	600.0	38509.2
BLS 4 PERCENT BASIC PROJECTIONS							
1966	-2.7	-15.4	-3.5	-6.4	-59.6	-1.4	-91.9
1967	-5.6	-31.5	-7.4	-13.1	-123.3	-2.9	-188.8
1968	-8.7	-48.2	-11.7	-20.1	-191.2	-4.5	-291.3
1969	-12.0	-65.7	-16.3	-27.4	-263.7	-6.2	-399.5
1970	-15.6	-83.8	-21.4	-35.1	-341.2	-8.1	-513.9
1971	-19.4	-102.7	-26.9	-43.1	-423.8	-10.0	-635.0
1972	-23.6	-122.4	-33.0	-51.4	-512.1	-12.1	-763.1
1973	-28.0	-142.9	-39.5	-60.1	-606.3	-14.3	-898.7
1974	-32.8	-164.2	-46.6	-69.3	-706.8	-16.7	-1042.4
1975	-37.9	-186.4	-54.4	-78.8	-814.2	-19.3	-1194.7
BLS 4 PERCENT HIGH DURABLES MODEL							
1966	-3.6	-10.2	-17.2	-21.7	-65.8	-.4	-22.2
1967	-7.5	-20.9	-35.8	-44.2	-136.3	-.9	-47.4
1968	-11.7	-32.1	-56.0	-67.5	-211.8	-1.5	-75.6
1969	-16.1	-43.7	-77.8	-91.6	-292.6	-2.1	-107.3
1970	-20.8	-55.8	-101.5	-116.5	-379.0	-2.8	-142.7
1971	-25.9	-68.5	-127.0	-142.3	-471.5	-3.6	-182.1
1972	-31.3	-81.8	-154.5	-168.9	-570.4	-4.5	-225.8
1973	-37.1	-95.6	-184.1	-196.6	-676.2	-5.5	-274.2
1974	-43.3	-110.0	-216.1	-225.1	-789.4	-6.6	-327.6
1975	-49.9	-125.0	-250.4	-254.7	-910.4	-7.8	-386.8
BLS 4 PERCENT HIGH SERVICES MODEL							
1966	-2.5	-24.4	8.8	-4.0	-62.2	-1.8	-133.2
1967	-5.2	-49.8	18.6	-8.0	-127.2	-3.7	-271.1
1968	-8.0	-76.0	29.6	-12.1	-194.9	-5.6	-413.8
1969	-10.9	-103.2	41.8	-16.3	-265.7	-7.7	-561.7
1970	-14.0	-131.4	55.3	-20.4	-339.7	-9.8	-715.0
1971	-17.3	-160.6	70.2	-24.7	-417.0	-12.0	-874.3
1972	-20.7	-190.9	86.7	-28.9	-497.8	-14.3	-1038.9
1973	-24.4	-222.2	104.8	-33.2	-582.3	-16.7	-1210.2
1974	-28.2	-254.7	124.8	-37.4	-670.5	-19.2	-1388.1
1975	-32.3	-288.3	146.7	-41.7	-763.1	-21.8	-1573.0

Source: Division of Operations Analysis, Office of Education

V. FURTHER DEVELOPMENT

A. Variable Education Coefficients

We are aware, of course, that the occupational structure of U.S. industry is subject to continuing evolution. Historically, this evolution has been characterized by increased demand for workers with higher skills and better education. These trends are not reflected in the OERA system which, as it now stands, uses a fixed set of coefficients for the period 1966-75.

It is feasible, however, to project many of these trends and BLS is preparing a study which does this (14). The results of this study will be two matrices showing the distribution of the work force among 166 occupations in each of 116 industries in 1960 and 1975. These occupations could be classified into the seven vocational education categories and the industries aggregated in a way that would permit the development of education coefficient matrices for 1960 and 1975 that conform to our basic projections data.

For the OERA, linear interpolations of coefficients from 1960 to 1975 can be made to yield a coefficient matrix for each of the years in our projection. The year-by-year calculation is based on linear interpolation. A better approach would be to incorporate cyclical and technological factors.

The methodological approach followed in obtaining the coefficients can be summarized briefly: The basis for most projections is the 1950-1960 shift in occupations indicated by the Censuses of those two years. This shift, modified as described below, was simply projected to 1975. These changes in coefficients were modified by reports on production/nonproduction worker trends in mining and manufacturing, i.e., the trends shown in the Census data were adjusted to reflect these later data.

A number of agencies and associations make carefully considered projections of employment of certain groups of workers. These are then used to "back in" to a ratio. Examples are the Post Office Department and other government agencies, the regulated industries (railroads, airlines), National Science Foundation projections of scientific and engineering employment, and the Public Health Service projections of medical and health worker requirements. Evaluation of emerging factors indicates possible directions. Examples: the corporate concentration of retail trade is leading to shifts in employment structure; the establishment of higher national goals in health has implications for growth in the health occupations, and technological trends such as the use of computers are shifting demand away from clerical workers.

The OERA system can be designed to utilize these BLS data as they are made available and, to the extent that BLS reviews and improves both its methodology and its data, these improvements can be reflected by the OERA system. We anticipate that these occupational shifts will have a very large impact on the structure of educational requirements.

B. A Rebasing System

While the projections of the National Planning Association seem to serve our purposes in most respects, they do not reflect current economic status. Since current projections are based on data which date back to 1962, the OERA system is, in effect, "projecting" historical situations. Comparisons made above make it clear, however, that important changes in industrial activity, especially at the SMSA level, may have occurred since the base year.

It would be highly desirable to incorporate current data in our projections in order to reflect these local shifts. Data used in making these adjustments are available from BLS sources and have been described elsewhere (12). The conceptual differences between the NPA projections and the BLS series have also been described. Despite these conceptual differences, techniques for converting the data of Reference 12 to a base comparable to those of the OERA system could be developed.

With such a methodology, the expanded OERA system would derive adjusted employment projections through the following steps:

(a) The industry-by-industry data, taken from current editions of Ref. 12 for States and SMSA's, are converted to their NPA-defined equivalents.

(b) The distribution of total current employment among industries and areas is computed and used to project the distribution in 1975.

(c) Using an overall control figure for projected employment in each industry in 1975, and the projected distributions among areas, a projected figure for 1975 for each area and industry is obtained.

Using these data for 1966 (or the current year) and 1975, as well as any intervening years which it appears appropriate to include, the computations already described in Section II can be made.

While we have described this system on the assumption that the BLS Employment and Earnings data would be used, it is clear that any other sources of current employment data could be similarly incorporated. The only requirement would be that the alternative source provide employment data which are conceptually equivalent to the NPA data, or which could be converted to a comparable basis.

C. Problems of Definition and Expansion

The OERA system described here has been illustrated by preliminary runs which summarize educational requirements into seven broad vocational education categories. The BAVLP has analyzed the occupations included in the latest

Dictionary of Occupational Titles (ref. 15) and has linked about 18,000 applicable (non-collegiate) titles to between 200 and 300 instructional courses in the seven vocational education programs. The incorporation of this degree of detail, carried down to the local level will prove to be as detailed as might be practical for program planning purposes.

The identification of labor market areas, and the projection of employment by industry within them, may prove to be difficult. Projecting employment at more detailed levels than the SMSA may involve so many artificial assumptions as to make the results almost valueless. The adequacy of the current area detail could be determined only by testing in the field.

D. Continuing System Development

The OERA system is obviously only one attempt to build a vocational education planning system. Some questions that remain to be answered are:

(a) How many new labor market entrants will be needed in each field? We have alluded in passing to our net figures which do not allow for attrition.

(b) How will new entrants receive their training or, to be specific, how many will the local vocational education programs have to provide?

(c) Then, finally, how can we convert these data to analyses useful for curriculum planning, staffing, planning of facilities, and funding at the local level?

Many other questions and recommendations will arise as additional work is done on relating educational system requirements to labor force needs.

APPENDIX A

Classification of Economic Sectors

Sectors used in OERA system		OERA system sectors as listed in Standard Industrial Classification 1/	
Number	Title	Number	Title
01	Agriculture	01-07	Agriculture
		08-09	Forestry & fisheries
10-14	Mining	10-14	Mining
15-17	Construction	15-17	Contract construction
19-39	Manufacturing	20-21	Food & kindred products
		22	Textile mill products
		23	Apparel & related products
		26	Paper & allied products
		27	Printing, publishing, etc.
		28	Chemicals & allied products
		29	Petroleum & related industries
		30	Rubber & plastic products
		31	Leather and products
		19	Ordnance & accessories
		24	Lumber & wood products
		25	Furniture & fixtures
		32	Stone, clay, & glass products
		33	Primary metal industries
		34	Fabricated metal products
		35	Machinery
		36	Electrical eqpt. & supplies
		37	Transportation equipment
		38	Instruments & related products
		39	Miscellaneous manufacturing

See footnote at end of table.

APPENDIX A (continued)

Classification of Economic Sectors

Sectors used in OERA system		OERA system sectors as listed in Standard Industrial Classification [1/]	
Number	Title	Number	Title
40	Transportation, Communications & public utilities	40	Railroad transportation
		42	Trucking & warehousing
		41,44-47	Other transportation
		48	Communications
		49	Utilities & sanitary services
50	Wholesale trade	50	Wholesale trade
52-59	Retail trade	54	Food stores
		58	Eating & drinking places
		52,53, 55-57,59	Other retail trade
60	Finance, insurance & real estate	60	Banking
70-80	Services	70-72	Hotels & personal services
		88	Private households
		73-76	Business & repair services
		78-79	Entertainment, recreation serv.
		80-86,89	Medical, other professional serv.
91	Federal government	91	Federal government
92-93	State & local government	92-93	State & local government

1/ U.S. Technical Committee on Industrial Classification, Office of Statistical Standards. Standard Industrial Classification Manual. (Washington: Government Printing Office, 1957), and 1963 supplement.

APPENDIX B

Computer Programs

We have already described the two programs used in OERA. The purpose of this Appendix is to provide more detail concerning punch-card layouts and deck setup.

A. The Coefficients Program

The COBOL program which produces the coefficients of employment by selected vocational education group requires two sets of input cards, one which gives the conversion from Census occupation to OERA occupation/education code, and a second which gives the Census industry-to-OERA-industry conversion. The first file card layout is:

Data Item	Card Column
A	1
Census occupation code	2-4
OERA occupation/ education code	5-8

The second file card layout is:

Data Item	Card Column
B	1
OERA industry code	2-5
Lowest in a range of Census industry codes*	6-8
Highest in the same range of Census industry codes	9-11

*Where there is only one Census industry code applicable to the OERA code, the highest and lowest will be equal.

Appendix Table A, for example, is a complete list of the conversion codes used in making up the "A" file for preliminary runs of the OERA system.

The two card files provide the information necessary to set up an industry-education cross classification in computer memory. On reading the 1/1000

Census tape, each record relating to an employed person is classified for counting into the appropriate matrix cell. After passing the tape file, each element is divided by its corresponding industry total giving the distribution of total industry employment by educational category.

The resulting matrix is punched out in the format:

Date Item	Card Column
Industry	1-4
Educational category	5-8
Coefficient	9-12
Repeat	13-18
"	19-26
"	27-34
"	35-42
"	etc.

As many cards as necessary to accommodate all education categories are punched.

B. The Projections Program

The projections program is written in FORTRAN. Its function is to apply the education coefficients produced by the coefficients program to state and SMSA employment projections and thus to obtain the occupation/education mix for each area for each year of the projection.

In addition to the coefficient matrix described above a data deck of projections is required in the format:

	Data Item		Card Column
	State code		1-2
*	SMSA code		3-5
	Industry code		7-8
**	Employment:	1950	11-15
		1957	16-20
		1960	21-25
		1962	26-30
		1970	31-35
		1975	36-40
***	Card code		80

* "999" where data refer to a state. Eventually we would expect the code to refer to Educational Planning Areas.

** Since only 1962,1970, and 1975 are used by the program, the other fields may be left blank. In some cases, data for 1970 were not available and an exponential interpolation from 1962-1975 had to be used.

*** "3" where data refer to a state, blank otherwise. See first note above.

In order to make the report more readable, names of SMSA's and states are printed as headings for their corresponding data. Cards carrying these data have the format:

Data Item	Card Column
State code	1-2
SMSA code (as above)	3-5
SMSA/State name	60-79
Card code "9"	80

The input file is made up as follows (beginning with the System data card):

*Data

19661967196819691970197119721973197419 75

(to set up the years in memory for printing)

The Coefficient Matrix
The Projections Data Deck
    SMSA Projections (followed by name card)
    State Projections(" " " ")
End of File Card ("8" in column 80)

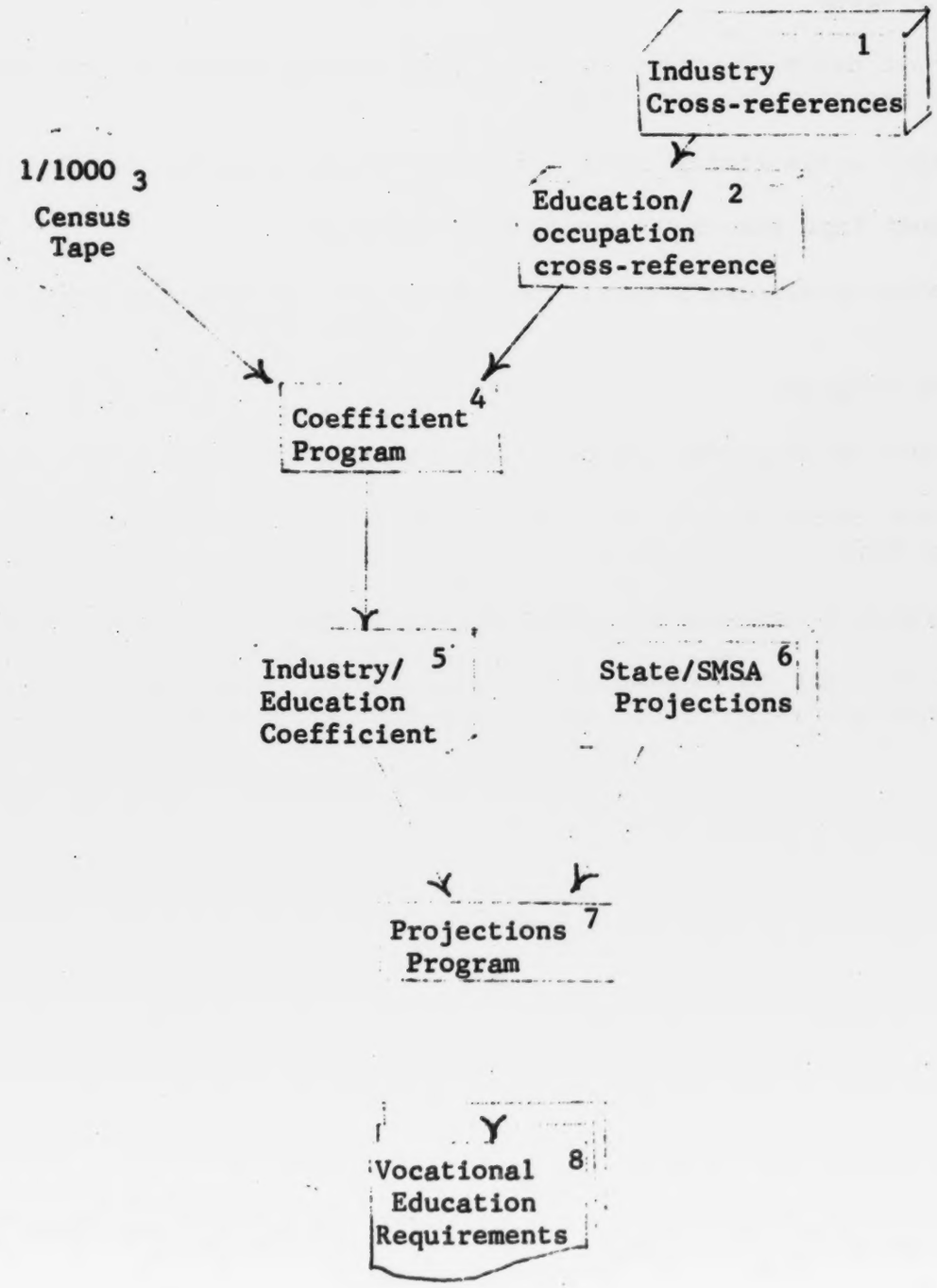

Fig. 3. Data Processing Flow

See key on following page.
For detailed explanation of data input and output, see page 7-12 and 30-32.

Fig. 3. Data Processing Flow (cont'd)

COBOL Program:

1. Input cards showing conversion from Census occupation to OERA occupation/education code.

2. Input cards giving conversion from Census industry to OERA industry.

3. Input tape showing occupation by industry.

4. Industry/education cross-classification (in computer memory).

FORTRAN Program:

5. Input cards giving industry/education coefficients.

6. Input cards showing NPA industry-employment projections by State and SMSA.

7. Program to project educational requirements by State and SMSA.

8. Output tape showing annual projections of vocational education requirements for the total United States, 50 States, and 82 SMSA's.

BIBLIOGRAPHY

1. Almon, Clopper Jr. The American Economy to 1975. New York: Harper & Row, 1966.

2. Boston Sunday Globe, March 12, 1967, page 8-A.

3. Hollister, Robinson G. Technical Evaluation of the Mediterranean Regional Project. Paris: OECD, 1965.

4. National Planning Association. Center for Economic Projections. Economic and Demographic Projections for Eighty-Two Metropolitan Areas. Regional Economic Projections Series, Report No. 66-R-1. Washington, May 1966.

5. _____. State Projections to 1975. Regional Economic Projections Series, Report No. 65-II. Washington, October 1965.

6. Parnes, H. Forecasting Educational Needs for Economic and Social Development. Paris: OECD, 1965.

7. U. S. Department of Health, Education, and Welfare, Office of Education. Projections of Educational Statistics to 1975-76 (1966 ed.), by Kenneth A. Simon and Marie G. Fullam. OE-10030-66. Washington: Government Printing Office, 1966.

8. _____. Standard Terminology for Instruction in Local and State School Systems (preliminary ed.), by John F. Putnam and W. Dale Chismore. Washington: Government Printing Office, May 1967.

9. _____. Technical Training in the United States by Lynn A. Emerson. Appendix I of Education for a Changing World of Work. OE-80022. Washington: Government Printing Office, 1963.

10. U. S. Department of Labor. Bureau of Employment Security. Directory of Important Labor Areas. 5th ed. Washington, July 1, 1965.

11. U. S. Department of Labor. Bureau of Labor Statistics. America's Industrial and Occupational Manpower Requirements 1964-75. Washington: Government Printing Office, 1966.

12. _____. Employment and Earnings Statistics for States and Areas 1939-65. Bulletin 1370-3. Washington: Government Printing Office, 1966.

13. _____. Projections 1970. Bulletin 1536. Washington: Government Printing Office, 1966.

14. _____. Tomorrow's Manpower Needs. Washington, unpublished draft, 1967.

15. U.S. Department of Labor. Manpower Administration. Dictionary of Occupational Titles. 3rd ed. 2 vols. Washington: Government Printing Office, 1965.

16. U.S. Technical Committee on Industrial Classification, Office of Statistical Standards. Standard Industrial Classification Manual. Washington: Government Printing Office, 1957, and 1963 supplement.